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(54) Title: THERMOPLASTIC MULTILAYER WATER TRANSMISSION TUBE

(57) Abstract

In a water transmission tube made of a thermoplastic and having a wall comprising at least two layers, the outer layer consists of a polyolefin material and the inner layer consists of a thermoplastic which is admixed only with substances required for processing it and which as such has no bacterial growth–promoting activity. The inner layer preferably consists of a thermoplastic which is selected from the group consisting of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), thermoplastic polyurethane (PU), acrylonitrile–butadiene–styrene (ABS) and polyethylene terephthalate (PET), and is preferably less permeable to organic substances than the outer layer.

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Thermoplastic multilayer water transmission tube

The invention relates to a thermoplastic water transmission tube.

Thermoplastic water transmission tubes are in general use and in most cases are eminently satisfactory. Water transmission tubes may however give rise to the problem of growth of bacteria on the inside of the tube. This is because water companies are increasingly adopting the practice of treating prepurified water destined to be drinking water not with chlorine, but with ozone or with UV light, in combination with filtration through a sand bed. This results in a better taste of the water and smaller amounts of organic chlorine compounds in the water, which are considered problematic in terms of public health. It is now found, however, that in the case of water purified in this manner in tubes of certain materials, in particular polyolefin materials, the gradual fouling by bacteria proceeds more rapidly than in tubes made of other materials. Particularly in tubes of polyethylene (PE) and to a lesser extent in tubes of polypropylene (PP) and polybutylene (PB) is relatively rapid fouling by bacteria observed.

To overcome the problem of fouling by bacteria in tubes designed to transport water it has been proposed to provide the tube with an inner layer in which a bactericidal substance has been incorporated (see for example US-A-5332160). Given the toxicity of the added substances, these tubes are not suitable, however, for drinking-water lines.

It is further found that many organic substances such as solvents readily permeate the wall of a tube of a polyolefin material. As a result, the use of water transmission tubes of polyethylene, polypropylene or polybutylene in soil contaminated with such substances has drawbacks, since the water transported through the pipes can become polluted.

To overcome this problem it has been proposed that tubes to be used under such conditions be provided with a layer which is made of another material and is impermeable or at least much less permeable to the pollutants. Preferably, said layer is then applied to or near the outside. A known material for this

purpose is aluminium in the form of a thin foil.

Also known, for example from EP-A-0686797, are multilayer plastic tubes for the purpose of transporting (petro)chemicals, comprising an outer layer on the basis of a polyolefin and an inner layer on the basis of a thermoplastic polyester. EP-A-0686797 states that these tubes are also suitable for transporting drinking water if there is the risk of pollution by diffusion from the outside to the inside, for example if drinking water lines are laid down in contaminated soil. Bacterial growth is not discussed, however.

It is an object of the invention to provide a water transmission tube made of a thermoplastic, in particular of a polyolefin material and more particularly of polyethylene, polypropylene or polybutylene, which tube gives rise to less fouling by bacteria within the tube, the tube preferably being suitable for use even in moderately contaminated soil.

This object is achieved by a water transmission tube according to claim 1.

Preferred embodiments of the water transmission tube according to the invention are defined in claims 2 to 6 inclusive.

It should be noted that the thermoplastics used for the inner layer are not admixed with any additional substances which inhibit bacterial growth, but that these plastics as such, i.e. in the form in which they are customarily used, do not or virtually do not give rise to bacterial growth.

A water transmission tube according to the invention can be fabricated by coextrusion, and tube sections can readily be joined together by means of customary joining techniques. Possible examples are joints by means of (electro-)fusion sockets, sockets with rubber rings and even butt-fused joints. A water transmission tube according to the invention is flexible and therefore highly suitable in cases in which the tube has to be laid in bent and/or coiled form (indoors or service pipes).

Water transmission tubes according to the invention can be used in various fields, the construction of the tube depending on the field of application.

A first field of application is indoors to transport cold and hot water. In this case, the diameters of the tubes are

usually relatively small, in the order of magnitude of from 15 to 32 mm. Since for these tubes the permeability to organic substances does not matter, but only bacterial growth is of importance, a thin inner layer is sufficient, for example having a thickness of 0.1 mm. The tube material, i.e. the material of the outer layer, can be polyethylene (PE), especially cross-linked polyethylene, usually referred to as PEX, polypropylene (PP), especially the so-called "random copolymer", or polybutylene (PB). Suitable materials for the inner layer for this field of application are above all polyurethane (PU) and chlorinated polyvinyl chloride (CPVC), both materials retaining their good properties at elevated temperatures.

A second field of application relates to service pipes. In this field of application the external diameters of the tubes are usually in the range from about 32 to 63 mm. The tube materials suitable for this application are, above all, various types of polyethylene, be they HDPE, MDPE or LDPE, the material optionally being cross-linked. Particularly suitable for the inner layer for this cold-water application are polyurethane (PU) and polyvinyl chloride (PVC). Amorphous polyethylene terephthalate (APET) and acrylonitrile-butadiene-styrene (ABS) are likewise suitable as a material for the inner layer. Since bacterial growth as well as permeation of pollutants may matter here, the inner layer will often have to be thicker than in the indoors application, since the thickness of the inner layer has a direct effect on the resistance to permeation. Layer thicknesses of from 0.2 to 0.6 mm are eligible for this purpose.

A third field of application is the use as a water mains pipe. The diameters of such pipes are often in the range of from 63 to 630 mm and possibly even larger. For this use too, both permeation and bacterial growth may matter, so that wall thicknesses of the inner layer of from 0.2 to 1.0 mm are desirable.

Experiments have shown that for the same layer thicknesses the permeability of PE to organic substances such as trichloroethylene, toluene, cyclohexanone and phenol is many thousand times larger than the permeability of PVC, PU, ABS and APET.

The table below gives an impression of the permeability ratios for the said substances, the permeability of PVC, PU, ABS and APET being defined as 1. In practice, this permeability will be even smaller.

Material	Trichloro-ethylene	Toluene	Cyclo-hexanone	Phenol
HDPE	100,000	5000	10,000	15,000
PVC	1	1	1	1
PU	1	1	1	1
ABS	1	1	1	1
APET	1	1	1	1

The experiments regarding bacterial growth have shown that in the case of PVC, CPVC, PU and APET under the same conditions the fouling by bacteria was smaller than in the case of PE by at least a factor of 20.

The following tables show examples of embodiments of water transmission tubes according to the invention in various fields of application. The material types PE 80 and PE 100 are PE types having different permitted wall stresses.

Tables with examples of tube types and their dimensions

D : nominal external diameter (mm)
E1 : nominal wall thickness of outer layer (mm)
E2 : nominal wall thickness of inner layer (mm)
M1 : material type of outer layer
M2 : material type of inner layer
PN : pressure class (bar)
S : tube class according to ISO 4065

1. TUBES FOR USE INDOORS

D	S	M1	E1	M2	E2
12	5	PEX/PB	1.3	PU/CPVC	0.1
16	5	PEX/PB	1.5	PU/CPVC	0.1
20	5	PEX/PB	1.9	PU/CPVC	0.1
25	5	PEX/PB	2.3	PU/CPVC	0.1

2. TUBES FOR USE OUTDOORS

D	PN	M1	E1	M2	E2
25	10	PE80	2.0	PU/PVC	0.2
32			2.4		0.2
40			3.0		0.2
50			3.7		0.2
63			4.7		0.3
75			5.6		0.3
110			8.1		0.5
160			11.8		0.6
200			14.7		0.8
250			18.4		1.0
315			23.2		1.0
400			29.4		1.0
500			36.8		1.0
630			46.3		1.0

D	PN	M1	E1	M2	E2
32	8	PE100	2.0	PU/PVC	0.6
40			2.0		0.6
50			2.4		0.6
63			3.0		0.6
75			3.6		0.6
110			5.3		0.6
160			7.7		0.6
200			9.6		0.6
250			11.9		0.6
315			15.0		0.8
400			19.1		1.0
500			23.9		1.0

CLAIMS

1. Water transmission tube made of a thermoplastic and having a wall comprising at least two layers, wherein the outer layer consists of a polyolefin material and the inner layer consists of a thermoplastic which is admixed only with substances required for processing it and which as such has no bacterial growth-promoting activity.

2. Water transmission tube according to claim 1, wherein the inner layer consists of a thermoplastic which is selected from the group consisting of polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), thermoplastic polyurethane (PU), acrylonitrile-butadiene-styrene (ABS) and amorphous polyethylene terephthalate (APET).

3. Water transmission tube according to claim 1 or 2, wherein the inner layer is less permeable to organic substances than the outer layer.

4. Water transmission tube according to any one of claims 1-3, wherein the thickness of the inner layer is smaller by at least a factor of 3 than the thickness of the outer layer.

5. Water transmission tube according to any one of claims 1-4, wherein the inner layer has a thickness in the range of 0.1 - 1.0 mm.

6. Water transmission tube according to any one of claims 1-5, wherein a bonding layer is present between the inner layer and the outer layer.

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16L9/133 F16L11/04 F16L11/12 F16L9/12

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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